Appendix B:
Pollution Prevention Case Studies

Appendix B is designed to help you get started doing P2 at your facility right away, and includes:

A Mini-P2 Guide for Printers

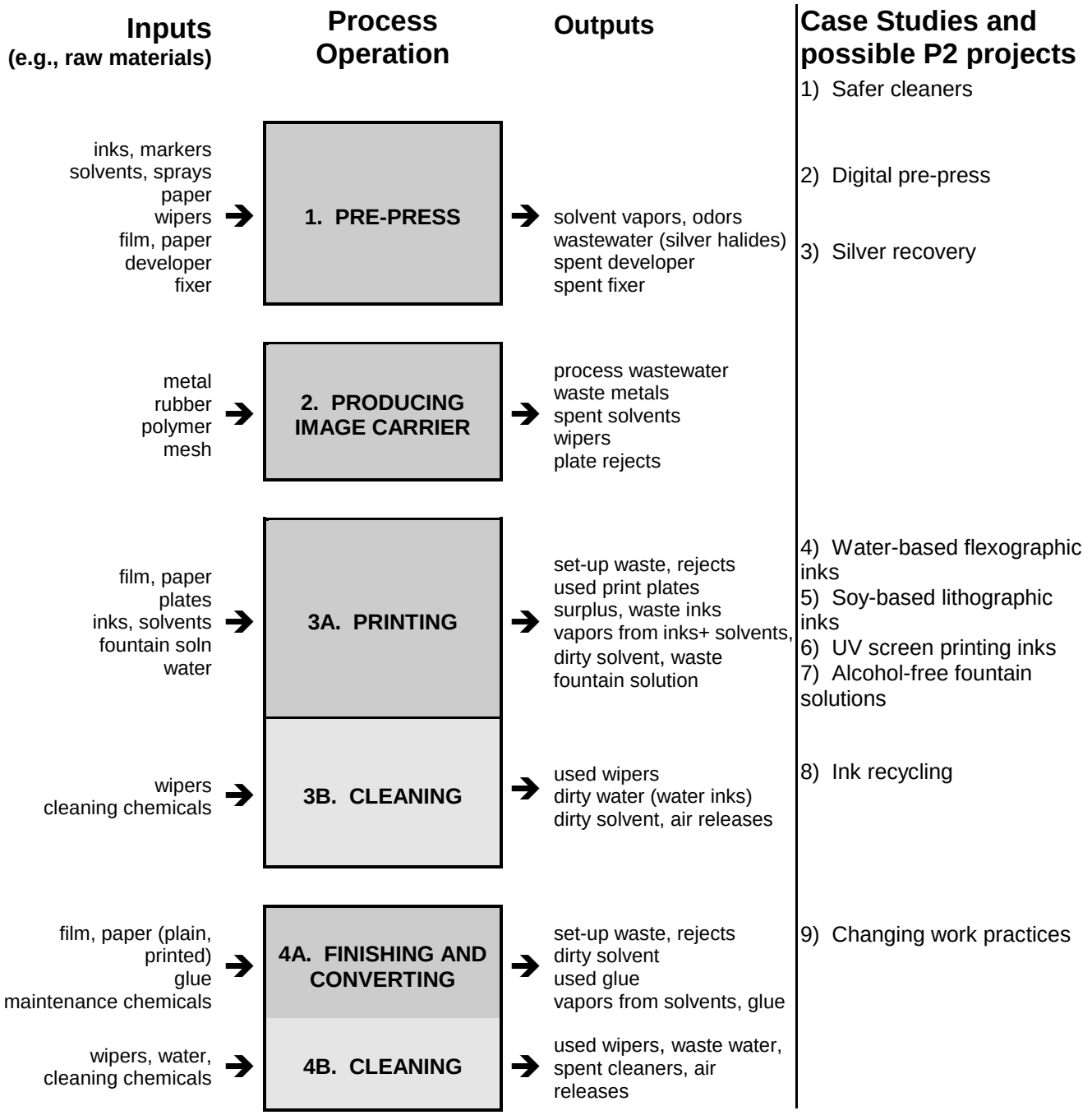
- **Getting Started**
- **Determining Costs**
- **Identifying P2 Opportunities**
- **Prioritizing your P2 Options**
- **Using Vendor and Customer relationships**

Getting Started!

To figure out where else you can reduce waste in your facility, or which changes will generate the most significant savings, start by making a "process map" or process flow diagram." The sample Process Map on page B**-2** will get you started. The map should show all the raw materials and energy you use in your process (inputs) and all products, wastes, and emissions your process creates (outputs). By writing this down, you can more easily identify which processes are generating the most waste, and then identify areas for possible P2 projects. The sample Process Map may not represent *everything* that should be on your flow chart, but you can use it as a starting point.

To create your process map, list each step in your process. For each step, write down what materials are going into the process step, the energy and water necessary for the process, and what's coming

Process Map



out. Include everything you can think of. For example, in addition to ink and paper, include other materials like shop towels, water, and electricity for inputs. For outputs, remember to include wastes such as evaporative losses and unusable raw materials, in addition to your waste ink and solvent. Remember to include steps in your diagram that are not directly part of the production process- steps like routine cleaning and maintenance.

Once your map is created, it is a good idea to tour the facility to complete and verify your process map. Talk to the lien workers, maintenance personnel and supervisors . Ask questions about why certain chemicals or processes are used, how the process could be improved, and what are the consequences of using a particular chemical or process.

Once your map is complete, you can use it to determine where your resources are going, identify P2 opportunities in your processes, and prioritize those opportunities (see below).

Determine Costs

Once you have developed a process map, you need to determine the costs associated with all the listed inputs and outputs. Wasted or "lost" raw materials can be expensive. When looking at waste generation costs, remember to includes more than just treatment and disposal costs- remember to include "hidden" costs. Hidden costs are costs associated with waste handling that are often overlooked because they are usually written off as overhead. For example, you may spend a lot of time and money complying with regulations for the waste you generate. These environmental expenses are often assigned to overhead costs, not to the processes responsible for them- thus "hidden" costs. Estimating costs is OK since many of these numbers are difficult to obtain. Activities typically hidden in overhead costs include:

- Reporting
- Record keeping
- Permits & fees
- Safety training
- Protective equipment
- Monitoring
- Labeling & storage
- Inspections
- Manifesting
- Insurance

Add these costs to your process map. Environmental cost accounting is the term used to look at how environmental costs are identified and allocated to each process of a firm's operations. When you use environmental cost accounting, your company will be able to bring environmental goals and financial goals together. More information on environmental cost accounting is presented on page B-6.

Identify Pollution Prevention Opportunities

Once your process map is complete, and associate costs have been assigned to each process, you can begin to identify areas for possible pollution prevention projects. Analyze the map to identify where your most expensive raw materials are going. Which wastes are most expensive to dispose? What causes your biggest regulatory burdens? What causes your biggest environmental headaches? Where are your biggest hidden costs? Where would you really like to make some changes? Answers to these questions can direct you towards areas that are ripe for P2 projects. Involve staff from all levels of the organization, from the shop floor to upper management, to include all perspectives. You do NOT have to be a P2 expert to begin doing P2 at your facility; there is lots of help available. There are a number of organizations, documents and websites that can help you identify possible P2 options (see P2 Assistance Providers in Appendix A).

Prioritize your P2 Options

Once you have a list of possible P2 opportunities, you need to prioritize them based on criteria that are important to your company. Three criteria often used are effectiveness, implementability and cost. It is a good idea to start with a few simple projects that are inexpensive to implement ("low-hanging fruit), then build on those successes. This whole process is a lot more fun and rewarding than it sounds- and it can save you big bucks!

How Can Supplier and Customer Relationships Help?

There are lots of new products on the market to help printers reduce their emissions, go beyond compliance, and make their products more environmentally friendly. Work with your vendors/suppliers to find alternative products that work for you.

Let your suppliers and distributors know that you're interested in finding out about products that can reduce your impact on worker and environmental health. Your role as a customer is powerful. Suppliers are often familiar with the latest pollution prevention technology, but have not offered them because you haven't indicated that this is important.. In turn, your customers may tell you that

they would like you to be environmentally conscious. In addition, the market is changing constantly and alternative products are always being introduced, so keep asking every 6 months or so.

You can also advertise your environmental accomplishments to help bring in more business, or apply for a NH Governor's Award for Pollution Prevention (www.des.state.nh.us/nhppp).

Where Can I go for Help?

There are lots of resources available to help your company become more environmentally friendly and save you money. Information and technical assistance resources for printers are listed in Appendix A.

Environmental Cost Accounting

Efficient production is dependent on accurate and consistent measurement of inputs and outputs. As is often said, "what gets measured gets managed." Without good cost information, it's difficult to set accurate prices for your products and services, assess your profitability, or (harder still) know what to change to make your business more profitable. Environmental cost accounting is how environmental costs are identified and allocated to each process of a firm's operations. When you use environmental accounting concepts, your company will be able to bring environmental goals and financial goals together. This shows how environmental improvement can lead directly to financial improvement.

When evaluating environmental investments, firms typically look at only the direct costs of equipment, raw material, labor, and waste disposal. Less obvious "hidden" costs associated with waste include permitting, reporting, insurance and liability are often over-looked. Conversely, hidden benefits from improved working environment and public image, should also be considered. By not including these less obvious financial impacts, a company may underestimate the benefits of a pollution prevention project and may reject a good investment.

In addition, some environmental compliance costs are incurred only when use of a material or generation of a waste exceeds a certain threshold; if you reduce your material use and waste generation below this threshold, or use a different chemical, you can save money on permitting and managing the waste.

Environmental Cost Accounting

A lithographer set out to determine if the capital investment in a computerized pre-press system was justified. The printer has 15-employees and annual revenues of $1 million. The firm currently sends any jobs it receives on diskette to a service bureau to produce film for platemaking. The company did a quick financial analysis to calculate the initial capital cost of installing a computer pre-press system and annual savings possible. Then they performed both a traditional cost analysis and an in-depth cost analysis that included environmental cost accounting (ECA). The ECA analysis revealed significant additional costs and savings. The differences in the results of the two types of analyses are shown in the table on the following page.

Traditional Cost Analysis	Environmental Cost Accounting Analysis
Savings	
reduced use of the service bureau	All savings listed for Traditional Cost Analysis, plus:
reduced courier charges	10% increase in revenue (due to faster turnaround, and gave them better process control)
	reduced labor for pre-press darkroom
	reduced labor for stripping operations
	reduced supervision cost
	reduced use of darkroom chemicals
	reduced use of external typesetting services
Costs	
Equipment costs	All costs listed for Traditional Cost Analysis, plus:
Installation costs	labor time to solicit and consider bids
	contractor work associated with accommodating the new equipment
	initial training costs
	new computer pre-press labor
	increased film costs
Results	
5-year net present value of $58,358	5-year net present value of $187,700
5-year internal rate of return of 51%	5-year internal rate of return as 132%
Payback period of 2.14 years	**Payback period of 0.82 years**

Source: Tellus Institute, . Snapshots of Environmental Cost Accounting"

What Environmental Cost Accounting Tools Are Available?

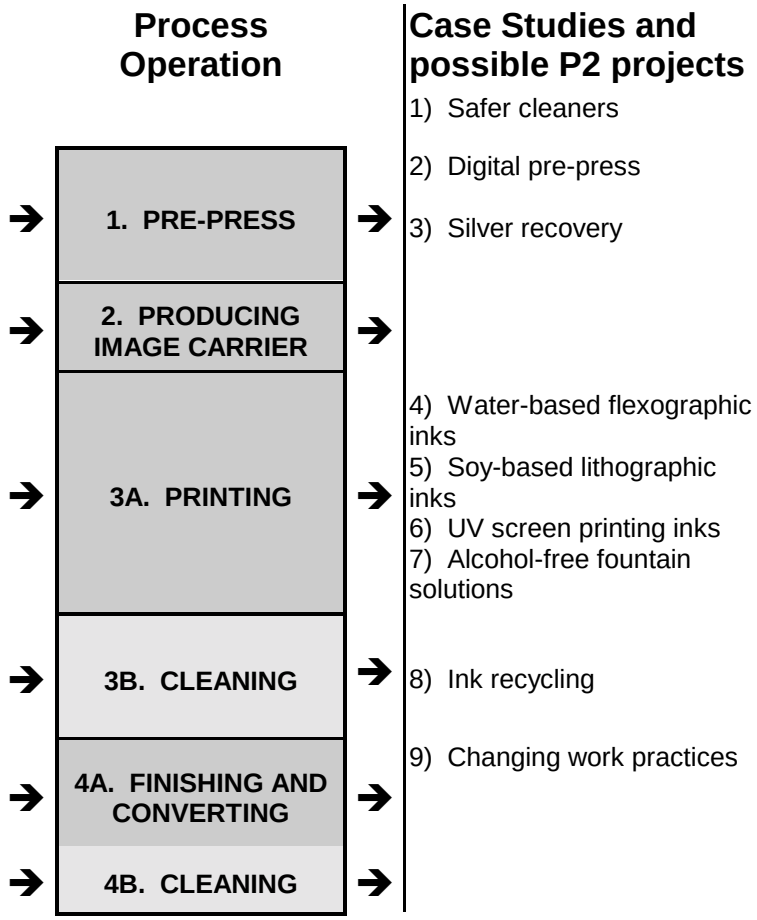
There are several good, free references available to help you analyze the true costs of waste and potential savings from P2 projects:

- ***Green and Profitable Printing*** is a video accompanied by a notebook. This was produced by the University of Wisconsin Extension, Solid & Hazardous Waste Education Center, in collaboration with the Graphic Arts Technical Foundation. They can be reached at (608) 262-7376 or fax (608) 265-3459.
- ***Snapshots of Environmental Cost Accounting*** includes case studies of printers and others who have applied these concepts written by Tellus Institute. You can contact Tellus Institute at (617) 266-5400, fax (617) 266-8303 or www.tellus.org.
- ***P2 Finance*** software packages have been designed for lithography, screen printing, and flexography. The software provides worksheets and instructions to walk you through the steps of conducting an environmental cost accounting assessment at your facility. Contact Tellus Institute at the number above.
- Check out EPA's Environmental Accounting Project's website at: www.epa.gov/opptintr/acctg.

Case Studies

There are lots of case studies available on the Internet or elsewhere. Presented below are a few that can be tracked on the flow chart on page B-2 (summarized below).

Case Study #	Type of Printing	Topic	Page
1	All	Safer cleaners	B-10
2	Screen	Digital pre-press	B-11
3	All	Silver recovery	B-12
4	Flexo	Water based inks	B-13
5	Litho	Soy based inks	B-14
6	Screen	UV curable inks	B-14
7	Litho	Alcohol free fountain soln.	B-15
8	All	Ink recycling	B-15
9	All	Changing work practices	B-16



Case Study 1: Safer Cleaners

Today, more and more cleaning formulations for printing presses and plates are safer than traditional solvents, which contained chemicals such as toluene and methyl ethyl ketone (MEK). The safer alternatives have been developed for both solvent- and water-based formulations, and can be applied both on and off press.

Printing facilities are using these alternative formulations with more than satisfactory cleaning results and without generating hazardous waste. One facility found that the cleaner was effective at penetrating the relief images of plates and required less brushing than most other cleaners on the market. At another facility, the safer cleaner provided better results with less hassle than the previously used product.

In the new solvent-based cleaning formulations, toluene and other hazardous petroleum distillates are replaced with aliphatic hydrocarbons and proprietary components. Many of the new water-based cleaners are low-foaming liquids that work when the water-based inks and coatings are still wet. However, most water-based cleaners are still not effective enough to clean water-based inks that are dried (e.g., plugged anilox rollers in flexography).

Source: Shapiro, Fred, "Cleaning and Quality: Partners in Reducing Pollution," FLEXO

Case Study 2: Digital Pre-Press

Print Design is a screenprinting facility. Because Print Design does not have a high-resolution output device, it uses service bureaus to generate camera ready art and proofs. Currently Print Design uses gelatin silver photographic film to generate positives from camera-ready art. However, since Print Design uses an on-site septic system, it is prohibited from disposing process water from its darkroom down the drain. Silver must first be recovered from the wash water, then wash water and fixer are collected separately for off-site disposal.

Increasing waste disposal costs and costly service bureau charges prompted Print Design to examine production changes that would decrease its reliance on waste haulers and service bureaus. One option, a dry film imaging system, would allow Print Design to generate positives directly from the computer, thus bypassing the darkroom. Not only would this option reduce service bureau charges, but it would reduce darkroom and waste disposal costs. However, this system had a limitation: the maximum width of dry film is currently 42 inches, but Print Design produces jobs up to 48 inches in width.

Print Design estimated costs to determine the feasibility of implementing a dry film imaging system. First, Print Design collected costs for its current pre-press process. Silver film, chemical costs and service bureau costs were available from the company□s general ledger. Labor costs associated with process camera operation were estimated. Investment costs for the new dry film imaging equipment were collected from the system vendor. A staff training budget was estimated. Because the dry film system could only handle jobs up to 42 inches wide, Print Design would continue to use the darkroom and service bureau for its widest jobs. However, the process camera operator would only be required half-time, and annual service bureau costs would be significantly reduced.

Print Design decided to implement the dry film system. This allowed them to get their jobs to press faster by avoiding the minimum 24 hour turnaround time required when using service bureaus. Therefore, the new system is expected to net Print Design additional earnings, because Print Design is now able to accept jobs it had to turn down in the past because of the turnaround time the service bureau needed would have taken too long to meet customer's deadlines.

Source: Tellus Institute, Boston, MA

Case Study 3: Silver Recovery

One Vermont printer significantly reduced the volume of wastewater it generated by implementing closed-loop recycling and evaporation. Part of this reduction was due to the elimination of film processor wash water. The company installed four small ion exchange units that were hard-piped to individual film processors. The ion exchange units remove silver from the wash water. The rinse water is then filtered to remove resin particles and is reused in the film processors.

The company also uses an electrolytic silver recovery unit to remove silver from spent fixer. An electrical current is applied to two electrodes immersed in the solution; silver is collected on one of the electrodes, removed periodically, and sold. An ion exchange system is also used to remove silver after the electrolytic silver recovery step. The de-silvered fixer is stored on-site until it can be evaporated. These steps reduced the volume of hazardous wastewater streams along with the costs associated with managing and disposing of the hazardous streams.

Source: Vermont Agency of Natural Resources, Pollution Prevention Division, Pollution Prevention Successes: A Compendium of Case Studies from the Northeast States, NEWMOA

Case Study 4: Ink Alternatives: Water-Based Flexographic Inks

A wide web flexographic printing facility in Illinois successfully reduced volatile organic compounds (VOCs) and hazardous waste by switching from solvent-based to water-based ink. The company manufactures decorative packaging products for the floral industry, producing approximately 125 to 150 million linear feet of product each year from flexographic presses.

The company found that its solvent-based inks (50 percent VOCs by weight) were the primary source of its VOC emissions. The company decided to replace its solvent-based ink system with a water-based system. There were many technical challenges with switching to water-based inks, including drying problems and variable print quality. However, the facility was dedicated to using the new system and conducted many hours of research to find solutions. For example, the company improved its drying systems by lowering temperatures and increasing air flow rates, and improved print quality by monitoring the pH and viscosity of the inks.

As a result of switching inks, the company reduced its VOC emissions 99 percent in seven years. The only VOC emitted is dipropylene glycol methyl ether, which is not a hazardous air pollutant (HAP). In addition, the facility completely eliminated hazardous waste from waste ink and cleaning operations. A small amount of non-hazardous solid waste is generated from disposable cleaning wipes. The reduction in VOC emissions and hazardous waste occurred even as the company's production more than doubled during the seven-year time frame.

Source: Design for the Environment Flexography Case Study 1: Reducing VOCs in Flexography, EPA 744-F-96-013

> *EPA's Design for the Environment Program: Through the DfE program, EPA develops and provides businesses with information to make environmentally informed choices and design for the environment. DfE forms voluntary partnerships with industry, public interest groups, universities, research institutions, and other government agencies to develop environmentally friendly alternatives to existing products and processes. Within each project, the DfE program ensures that the information reaches the people who make the choices - from managers to industrial design engineers to materials specifiers and buyers.*

Case Study 5: Ink Alternatives -- Soy-Based Lithographic Inks

A printing facility in Illinois was one of the first sheetfed offset printers in the U.S. to use soy-based inks. The main potential environmental benefit claimed for soy-based inks is that they emit fewer VOCs than traditional petroleum-based inks. Sheetfed soy-based inks are defined as those that have a minimum of 20 percent soy oil by volume.

This facility found that it uses 17 percent less soy-based ink than petroleum-based ink. This difference is offset by the slightly higher cost of soy-based inks. However, there are other less tangible benefits to using soy-based inks, including improved company image, improved employee morale, and customer preference for the product. Other factors, such as makeready time, product appearance, and cleanup effort, remain essentially the same. The facility's customers found the print quality acceptable, and many prefer to have their jobs printed with the soy-based inks.

Source: Simpson, Beth, et. al., Project Summary: Waste Reduction Evaluation of Soy-Based Ink at a Sheet-Fed Offset Printer, Risk Reduction Engineering Laboratory, EPA 600-SR-94-144

Case Study 6: Ink Alternatives: Ultraviolet-Curable (UV) Screen Printing Inks

A screen printer doing about one million dollars of business installed a UV curing process, which eliminated 40 percent of their solvents and solvent-based inks. Currently, the company uses the UV process for 80 percent of its work. All regulatory limits on chemicals and metals in their wastewater have been met.

In the past, using solvent inks, the presses had to be cleaned every 100 to 150 sheets to ensure ink would not dry on the screens. This was time consuming and affected the consistency of the jobs. The new UV process has reduced the need to stop work to inspect and clean the press.

Although this printer is reinvesting in new materials to make the operation more amenable to this process, they are noticing both an increase in profits due to new jobs with firms that like the high-gloss finish, and savings in production and labor costs. Since the UV unit was installed, business has increased by 20 percent and is growing.

Source: Massachusetts Office of Technical Assistance

Case Study 7: Alcohol-Free Fountain Solutions

A folding carton manufacturer and printer in Massachusetts was using large amounts of isopropyl alcohol (IPA) in the fountain solution for its offset printing presses. The company was generating up to six 55-gallon drums of waste solution per month from four sheetfed offset presses. To address the economic, health, and environmental concerns of using IPA, the company installed a new alcohol-free fountain solution delivery system. Reverse osmosis equipment was also installed to filter water and adjust pH and conductivity, because IPA substitutes are less tolerant to variations in water quality.

By switching to an alcohol-free fountain solution, the company has nearly eliminated VOC emissions and also realized cost savings. The new fountain solution delivery system cost $108,000, but the cost savings in material costs alone provided a payback period of less than two and a half years. In addition, there are substantial cost savings from increased production efficiency, reduced disposal costs, and reduced permitting costs.

Source: Toxics Use Reduction Case Study: Alcohol-Free Fountain Solutions at Americraft Carton, Inc., Office of Technical Assistance (OTA)

Case Study 8: Ink Recycling

A newspaper company wanted to recycle its ink but couldn't afford an on-site recycling system. The company decided to use a third-party, mobile ink recycling service which didn't require extensive capital investment. The company collects its waste ink, keeping process colors and black in separate drums. The recycling service treats and recycles the waste ink, producing ink that is ready for reuse. Only paper residue from the original waste stream needs to be disposed of. The company saves approximately $20,000 per year in disposal costs and $10,000 per year in labor costs by not having to manage the hazardous waste stream.

Source: Newspaper Association of America, Pollution Prevention Manual

Case Study 9: Effectively Changing Work Practices

Let's face it- few people like change. One printer in Minnesota discovered that addressing employee concerns in advance of making process changes helped ensure success of their P2 project. When considering a change of cleaning solvents to more environmentally-friendly products, the company needed to find a technical solution that met production requirements and develop new cleaning procedures that would work with lower vapor pressure cleaning solvents. However, each press crew used different methods to clean press printing blankets. The company needed to get the crews to buy into changing their very personal cleaning methods to the new method.

The company prepared three documents to help the transition. The first document contained background information and highlighted potential and real costs of not changing, as well as the benefits to the environment and working conditions. The second document provided a clear, step-by-step description of the new cleaning procedure. The company described exactly what the press operator would experience in using the new procedure and product, specifically what it would look like, what it would smell like, and what it would feel like. Providing these important details gave the company tremendous credibility with all of the crews, because there were no surprises. The third document presented frequently asked questions that were raised in earlier interviews with different crews.

As a result of the thorough preparation, the change in work practices and cleaning solvent was completely successful. Today, all cleaning solvents are recovered and recycled back to the facility for reuse. The company eliminated costly hazardous waste disposal, improved indoor air quality, maintained production performance standards, and gained customer and community good will. In addition, employees recognized that they had a very big role in the success story.

Source: Jeff Adrian, The John Roberts Company